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DEPARTMENT OF COMMERCE
BUREAU OF STANDARDS
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GENERAL NOTE.

Owing to the current nature of the investigations mentioned in the Technical News Bulletin, sometimes it will be impossible to supply printed information regarding them. However, in these cases, when the investigation has progressed sufficiently far, the Bureau will be pleased to furnish technical data to those engaged in the particular application of the subject, in order to avoid the delay incident to publication.

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Attention is called to an error in Bulletin No. 44. On page 7 (item No. 16 - "Artificial Seasoning of Gage Steels"), paragraph 6 should read "The plain carbon steel (containing 1.13 per cent carbon) ******."

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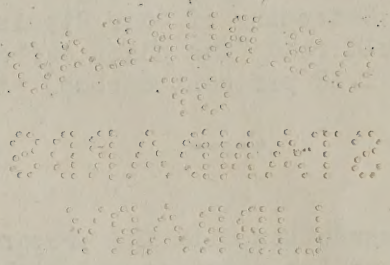
1 Performance of Starting and Lighting Batteries

In connection with the preparation of specifications for starting and lighting batteries requested by the Motor Transport Corps of the Army, the Bureau has made a brief study of the performance of these batteries in the operation of a few of the various types of automobiles; the experiments having been made on cars in ordinary running order. Performance curves showing the instantaneous demands upon the batteries when cranking the engines have been obtained by means of oscillograph records, these records showing characteristic differences typical of the design and condition of the various engines and starter systems. The initial values of current and voltage, which cannot be obtained by the use of ordinary indicating instruments, are shown at the time of closing the starter switch. After the starter has begun to turn, the current decreases rapidly, pulsating with the compression of the



successive cylinders. An interpretation of the curves shows that much additional information could be obtained with respect to the operation of the starter system and the engine itself. The results which have been secured are to be regarded as suggestive rather than quantitative measurements of performance. They indicate the possibility of using this method for the study of problems relating to lubrication, ignition, compression, and distributor action. In addition, an exact method is secured for measuring the speed from one revolution to another. The characteristics of the charging current when the engine was running were also studied. Measurements have been made at different speeds, different throttle openings, and different temperatures.

2 Gas Appliance Design

As has been stated in previous issues of the Bulletin, an investigation of gas burner design and operation was begun last year in cooperation with the Industrial Fuel Committee of the American Gas Association. The part of the problem particularly assigned to the Bureau was the proper design of air shutter, gas orifice, and burner throat to give the maximum injection of air under the ordinary conditions of use of gas. The results of the first part of this work are covered in a paper entitled "The Design of Atmospheric Gas Burners". The manuscript of this paper has received favorable comment from gas engineers and it is expected that the publication will appear soon after the first of the year. The work covered in this report refers primarily to industrial burners but the urgent need for improvement in domestic burners, especially those used for natural gas, has led to a study of such devices.

3 Standards for Gas Service

Among the earliest work of the Bureau's public utility problems was a study of standards for gas service. Circular No. 32, which deals with such standards, has gone through three editions, the last of which was issued in 1915. Since that date conditions in the gas industry have changed very materially. While the fourth edition of the circular has been in course of preparation for a considerable time, its publication has been withheld for nearly a year because of these unsettled conditions. It is expected that the new edition will be released in January, 1921, and will include

practically all the changes in standards to the end of 1920. A very full discussion is given of the causes which have compelled changes in standards, and the significance of such changes. All the material has received careful consideration by a large number of engineers and the recommendations which are made in the Circular represent the consensus of expert opinion on these matters.

4 The Year's Progress in Radio Telephony

In connection with research work at the Bureau of Standards on radio telephony, it is necessary to keep in touch with progress in this subject elsewhere. A review of recent developments and achievements has been prepared for publication in the Electrical World.

The past year has witnessed steady progress and increasing public interest in radio telephony. Voice transmission by radio waves has advanced from the experimental stage to established practice, for distances of a few hundred miles, and since all inherent difficulties have been surmounted, it is actually possible to carry on reliable radio telephony over as great a distance as ordinary wire telephony. It seems probable that commercial telephony across the Atlantic will be an established fact in the not far distant future. The quality of transmitted speech or music is as perfect as in ordinary wire telephony.

5 Inductance Coils in Radio Communication

The inductance coil is one of the fundamental elements in all radio circuits and improvements in the efficiency of radio systems depend very largely on the design and nature of these coils. There has been hitherto no comprehensive information available on the constants and behavior of such inductance coils. A careful research along these lines has been in progress at the Bureau having in view the use of coils both in practical radio operating circuits and as standards. The inductance, resistance, and capacity of typical coils have been measured, and studies have been made of the theory governing their resistance and capacity. These quantities change with the frequency, and predetermination of their value is of considerable importance in radio design. The results of this work have given formulas for calculating the capacities of short single-layer solenoids, pancake coils, and multi-layer coils of circular or square

section and large diameter. Special design shielded coils of calculable capacity have been developed for use as standards.

6 Magnetic Testing of Twist Drills

The Bureau is taking part in a cooperative investigation by a Committee of the American Society for Testing Materials on the testing of twist drills by magnetic analysis. The steel has been specially prepared by one member of the Committee and tested for homogeneity by a magnetic method at the Bureau. The drills are to be manufactured from this steel by another member of the Committee under carefully controlled conditions, after which they will be tested again magnetically by various members of the Committee. Following the magnetic tests, the drills will be returned to the manufacturer, who is to give them a thorough mechanical test. The Committee will then meet and attempt to correlate the mechanical performance of the drills with the results of the magnetic tests. The ultimate object of this investigation is the development of apparatus which can be used in a commercial way for the non-destructive testing of twist drills. The special apparatus for this work is in process of construction at the Bureau.

7 Hardness of Steels Produced by Abrasion

The relative hardness of various types of steels produced by subjecting all to the same abrading influences has been determined with the following results: In all cases except the high-carbon austenitic steel, no pronounced effect of the abrasion upon the steels used in these experiments was observed. In all cases the hardness of plain carbon steel is increased and among steels of this type the steel containing 0.85% shows the greatest increase in hardness. The alloy steels generally show a smaller increase in hardness of abraded surface than plain carbon steels, and in some cases they show a decrease of surface hardness. High-carbon austenitic steel shows a marked decrease of Brinell and scleroscope hardness. This process of abrasion viewed in the light of Beilby's Theory may be considered as resulting in the production of amorphous matter at the expense of crystalline matter which affects the hardness of the abraded surface of the metal but probably not the general character of its structure. As to the decrease of Brinell and scleroscope hardness of high-carbon austenitic steel, the following

explanation may be suggested: According to Benedick's Pressure Theory, the martensite should be present in a greater amount on the lower layer of the examined specimen than in the inner portion and it seems possible that if the surface layer is ground away the next or more austenitic layer should be found to be somewhat softer.

8 Temper Brittleness of Steels

An extensive review of the literature on this subject has been made with the result that the nature and occurrence of temper brittleness may be summarized as follows: Certain steels which have been hardened by quenching from temperatures above the A_3 point and tempered at temperatures ranging from about 450 to 600°C show less impact values if they are cooled slowly from tempering temperature as compared with those cooled quickly. The cause of this phenomenon, which is also referred to as "Krupp Krankheit", has not yet been clearly established. The property of temper brittleness has been found present in carbon steels .25 to .4%C, nickel, chrome-nickel, chromium, and certain other alloy steels. Chrome-nickel steels of the same chemical composition and heat treatment have been found to vary widely in their susceptibility to temper brittleness and even in the opposite direction, i.e., the slowly-cooled specimens were tougher than the quickly-cooled ones. The process of manufacture appears to have more of an influence than small changes in chemical composition, thus, steels made by the acid open-hearth process are more prone to temper brittleness than electric or crucible steels. The opinion has been advanced that the degree of work and the temperatures employed during the process of fabrication from the ingot bear some relation to the degree of susceptibility to temper brittleness. Other factors appearing to have an influence on the subject are the temperature of hardening preceding tempering treatment, degree of hardening, as cooling in water, oil or air, the rate of cooling from tempering temperature, phosphorus content, and the furnace atmosphere in which the material is treated. Other questions bearing upon the problem and upon some of which no general agreement has been reached and concerning which but little knowledge appears to be available are: relations between microstructure and susceptibility to temperature brittleness, path of rupture, heating and cooling curves, relation between impact

values and tensile test values as well as the Brinell hardness values, and the influence of the shape of the notched specimen upon impact test values.

9 Addresses Before Three Branches of the Electroplaters' Society

During the month a member of the Bureau's staff has delivered addresses at meetings held by three branches of the Electroplaters' Society upon the importance and possibilities of research in electroplating, especially such as can be carried out by cooperation with electroplaters, chemists, and manufacturers during a period when there is relatively little industrial activity, as is the case at the present time. It is felt that as far as conditions permit, it is desirable for representatives of the Bureau to visit these branches of the Electroplaters' Society in order that the members of staff may become better acquainted with those in the industry and the problems which are in need of study. It is hoped that through such association, it will be possible to make the work of the Bureau more immediately useful and also secure a more extended application of the results in everyday electroplating work.

10 The Carbonization of Lubricating Oils

A recent publication, Circular No. 99 of the Bureau of Standards by C. E. Waters, is devoted to this important subject. The paper may be summarized as follows:

The nature and effects of the deposits formed in internal combustion engines are discussed. It is shown that the term "carbon" is a misnomer because the deposits consist largely of asphaltic matter. Brief accounts are given of the nature of petroleum oils and of the theories concerning the formation of deposits. The oxidation and cracking of petroleum are discussed in detail. Carbonization tests which depend upon oxidation and upon cracking are next taken up. Full descriptions of the apparatus and procedures for the "Waters" and "Conradson residue" tests are given. Distillation methods are also touched upon. The general discussion gives brief summaries of certain controvertial papers and finally it is pointed out that there is yet much to be learned upon the whole subject of lubrication of internal combustion engines.

11 Causes and Prevention of the Formation of Non-Condensible Gases in Ammonia Absorption Refrigeration Machines

Technologic Paper No. 180 on this subject has recently been issued and may be secured in complete form from the Superintendent of Documents, Washington, D. C., at a cost of 5¢ per copy. The paper may be summarized as follows:

In the experiments conducted at this Bureau,

the conditions existing during the operation of an ammonia absorption refrigeration machine were duplicated. It was found that the presence of the non-condensible gases that cause so much trouble in the operation of these plants is due to either of the following causes: (1) leaks of air into the system, and (2) the corrosive action of the aqua ammonia on the metal of the plant.

If the foul gas is mainly nitrogen, the gas is derived from the air that is leaking into the system. The oxygen originally present in the air is quickly used up when the plant is operated and so will be present in only a very small percentage of its original amount. On the other hand, if the foul gas is hydrogen, the cause is corrosion by the ammoniacal liquor. Pure aqua ammonia will not cause gas formation but if salts of such weak acids as acetic or carbonic acid are present in the aqua, the corrosive action will continue during the life of the charge. If the gas in the plant contains both nitrogen and hydrogen, both causes are present.

The corrosive action of impure aqua may be completely stopped by the addition of either sodium or potassium dichromate to the aqua in the plant. The dichromate is conveniently added in the form of a concentrated solution and gas formation will be stopped if the salt is added to the extent of .2% of the weight of the aqua present. It is best to add the dichromate to the charge in all plants as its presence decreases the very small amount of gas caused by even the highest grade ammonias.

12 Recent Publications on Paints

The following circulars are now ready for distribution and may be bought from the Superintendent of Documents, Washington, D. C., at 5¢ a copy:

Bureau of Standards Circular 102 - Recommended Specification for Composite Thinner for Thinning Semi-Paste Paints When the Use of Straight Linseed Oil is not Justified.

Circular 103 Recommended Specification for Spar Varnish.

" 104 Recommended Specification for Asphalt Varnish.

" 105 Recommended Specification for Liquid Paint Drier.

13 Definitions and Specifications of Lime

A previous publication on this subject has already been referred to in the Technical News Bulletin. Circular No. 106 is now ready for distribution by the Superintendent of Documents,

briefly
Washington, D. C., at 5¢ a copy. It contains/the following information:

Limestones are classed as high calcium or magnesian according to the ratio of lime to magnesia which they contain. According to their physical structure, they vary from marble to chalk. Crushed stone of various sizes is used for blast furnace flux, aggregate for concrete and asphalt, ballast, road metal, sand, whiting, etc. It is also a basic raw material used in the manufacture of cement, glass, pottery, and many other things. Agricultural lime used as a fertilizer may be ground limestone, quick lime, or hydrated lime. Quick lime is made by burning limestone. It is used as a building material and as an ingredient of mortar and plaster. Slack lime is made by adding water to quick lime to form a body. Hydrated lime is made by adding just enough water to quick lime to form a dry powder. It is used as a building material instead of quick lime and also as an addition to cement, mortars, and concretes. Both quick lime and hydrated lime are used as basic raw material in the manufacture of paper, sugar, bleaching powder, alkalis, etc. Air-slaked lime is worthless as a building material and is seldom an article of commerce. Quick lime is shipped in barrels holding 180 or 200 lb. and hydrated lime in paper bags holding 50 lb.

The circular describes the quantity of lime required for making plaster and mortar as well as the amount for use as fertilizer. A formula for making whitewash is likewise included. Hydrated lime should contain not more than 5% impurities nor 3% carbon dioxide. It should be of such fineness that not more than 1/2% shall remain on a No. 30 sieve nor more than 15% on a No. 200 sieve. It should pass the prescribed steaming test for soundness.

14 Test of Grain Hopper Scales

The work of the Bureau in testing railroad track and other scales has been mentioned quite often in previous numbers of the Bulletin. Recently a test was carried out on a grain hopper scale of 120,000 lb. capacity located at Kansas City, Kansas. The work was done for the State of Kansas and other interested parties, including the Southwestern Milling Company, the Kansas City Chamber of Commerce, several railroads, the Western Weighing and Inspection Bureau, and the manufacturer of the scale. The test was one of the most thorough ever given to a scale of this kind. In addition to the ordinary testing by the application of weights, the dimensions

of the scale parts were measured and its capacity determined by means of computations based on these dimensions.

15 Table of Equivalents of Cubic Feet and Cubic Meters

There has been compiled for distribution, especially to firms interested in foreign shipments, a table of equivalents of cubic feet in terms of cubic meters arranged in units from 1 to 1,000 cubic feet, also cubic meters in terms of cubic feet, the arrangement being by tenths from 0.1 to 29 cubic meters.

16 Tests of Leather Made from Rabbit Skins

There has been received through the Bureau of Foreign and Domestic Commerce several samples of leather made from Australian rabbit skins. These samples were tested for tensile and tearing strength. The tensile strength was low, averaging from 800 to 1200 lb. per sq. in. as compared with 4,000 lb. per sq. in. for calf skin leather. The leather also exhibited but little resistance to tearing. Some of the raw pelts were tanned in the laboratory by the one-bath chrome process, the resulting leather having about the same physical properties as the original samples. In general, the samples had many surface defects which would impair their cutting value and the small size of the skins would tend to cause considerable waste. However, it is thought that the leather could be employed for linings, novelties, and other similar work. The United States Consular report states that the leather has been used for shoe uppers.

Respectfully,

S. W. STRATTON

Director
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